Internet Addressing and the RIR system

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Phnom Penh, Cambodia

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Overview I

- What is an IP address?
  - What types of IP addresses are there?
- IP address management
  - Evolution of IP address management
- Introduction to APNIC
  - What is APNIC?

Internet Protocol Addresses

*What are they like and
how do they behave?*

"On the Internet, nobody knows you're a dog…"

"On the Internet…"
you are nothing but an IP Address!

66.187.232.50

210.239.35.90

202.12.29.20

4.17.168.6

66.135.208.101

66.135.208.88

209.247.36.12

199.103.45

199.166.24.5

Internet for everything!
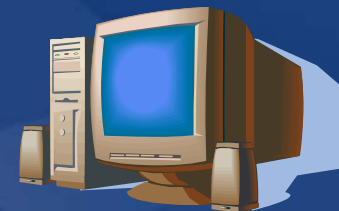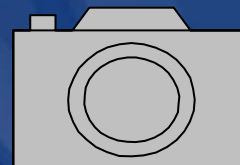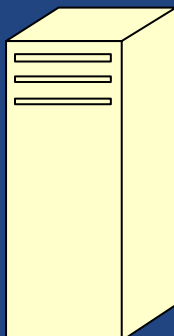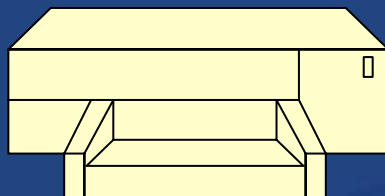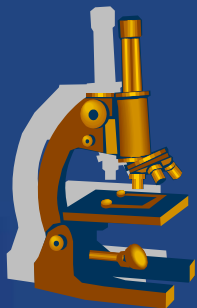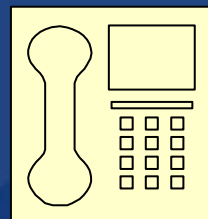
What is an IP Address?

Overview

- What is an IP address?
  - …and what it is not
- Internet address routing
- What is an IP address like?
  - IP address characteristics

What is an Address?

- An identifier which includes information about how to find its subject
    - (according to some rules of interpretation)
- Normally hierarchical
    - Each part provides more specific detail
- For example…
    - Room x, Level M, Sunway Hotel Phnom Penh, Cambodia
    - www.itu.int
    - pwilson@apnic.net

What is an IP address?

- *Internet identifier including information about how to reach a location*
    - *(via the Internet routing system)*
- IPv4: 32-bit* number
    - 4 billion different addresses available
- IPv6: 128-bit number
    - 340 billion billion billion billion addresses available
- For example…
    - 202.12.29.142   (a computer)
    - 202.12.29/24   (APNIC's network)

* bit = binary digit

Internet address routing

The Internet

Global Routing Table
4.128/9
60.100/16
60.100.0/20
135.22/16
202.12.29.0/24
…

**Announce
202.12.29.0/24**

**Traffic
202.12.29.0/24**

202.12.29.0/24

Internet address routing

Traffic
202.12.29.142

Local Routing Table

202.12.29.0/25
202.12.29.128/25

Local Router

202.12.29.142
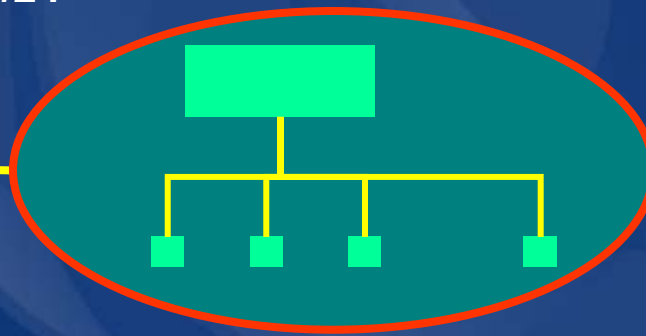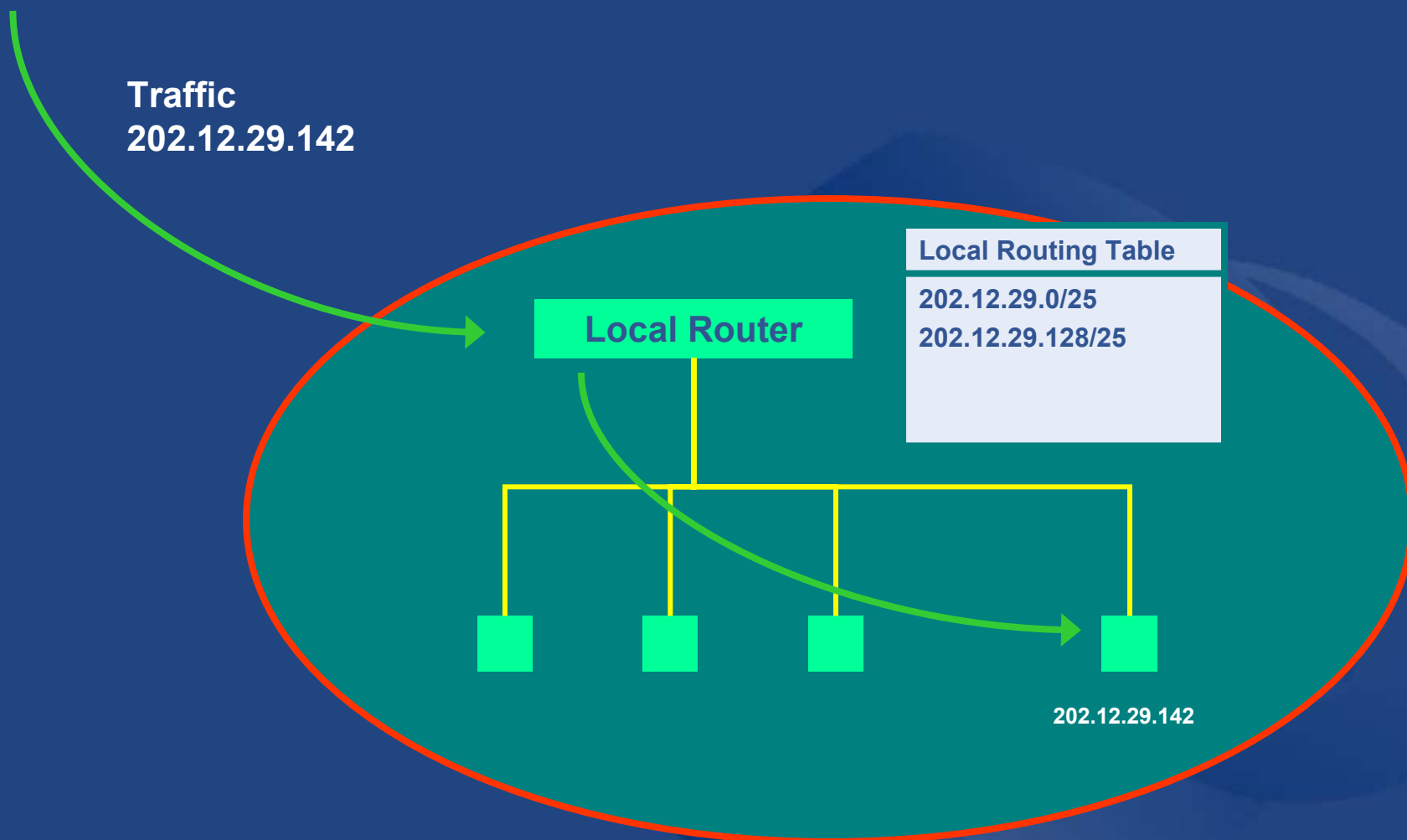
What else is an IP address?

- IP addresses are…
  - Internet infrastructure addresses
  - a finite Public Resource
  - not "owned" by address users
  - not dependent upon the DNS

- IP does not mean "Intellectual Property"

IP addresses vs domain names

The Internet

DNS

202.12.0.46
www.cernet.net ?

My Computer
202.12.29.142

www.cernet.net
202.112.0.46
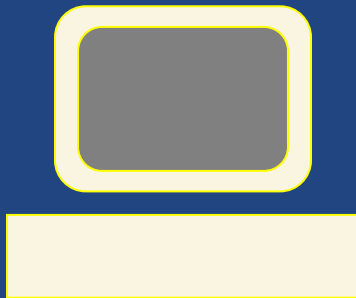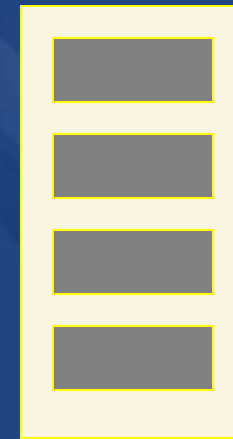
IP Address Characteristics

What is "my" address?

- IP Address = Network interface address
  - Not a computer's address
  - Nor a person's address

Modem

?

802.11

IPv4

LAN

IPv6
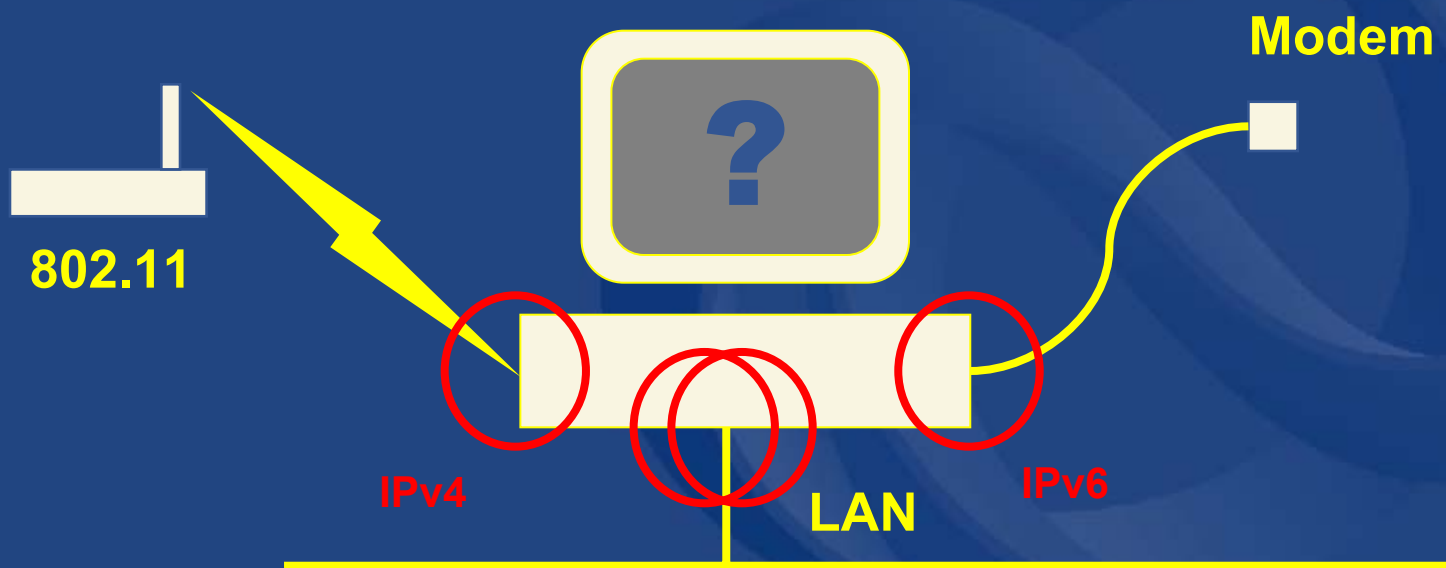
Is "my" address permanent?

- No - Customer addresses often change
  - Dialup addresses are "dynamic"…

ISP

132.234.250.30

Is "my" address unique?

- Not necessarily…
  - Public IP address = unique
  - Private* IP address = non-unique

ISP

ISP

202.12.0.129

NAT / firewall

192.168.0.142

192.168.0.0/24
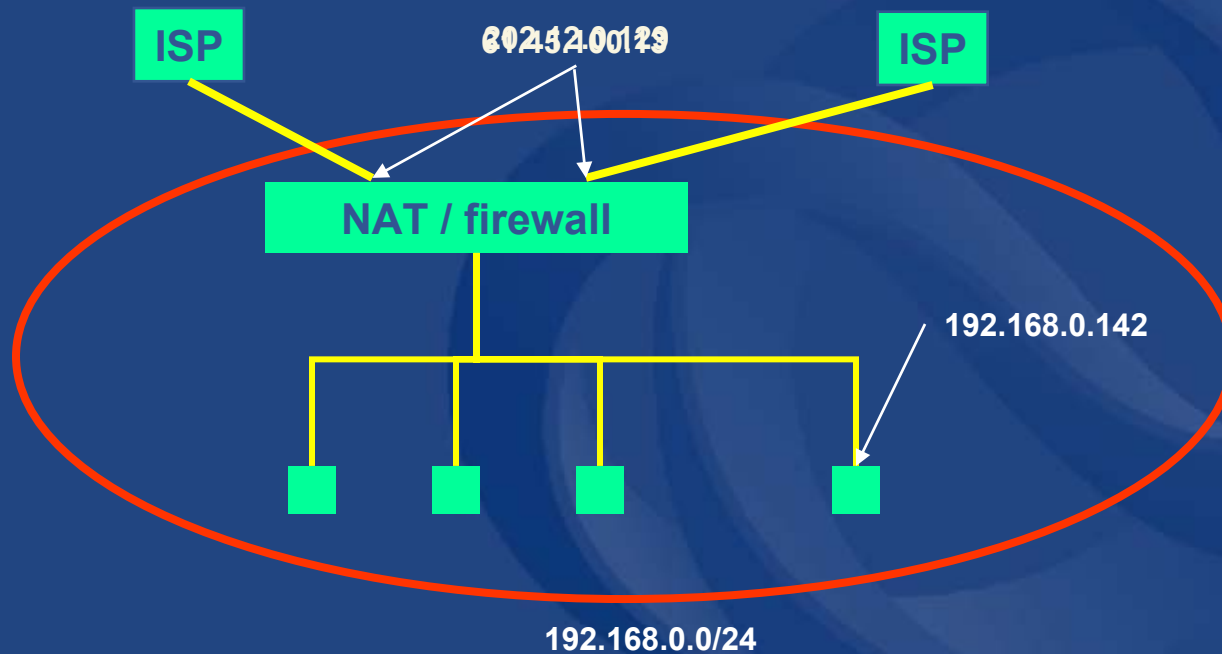
* RFC 1918

Summary so far

- IP Addresses identify location
  - Provide specific information for routing
- IP Addresses identify interfaces
  - Not computers, companies or users
- IP Addresses often change
  - And may not be unique

IP Address Management

Overview

- Early address management
- Evolution of address management
- Address management today
- Address policy development

Address Management – pre 1992

RFC 1020
1987

RFC 1261
1991

RFC 790
1981
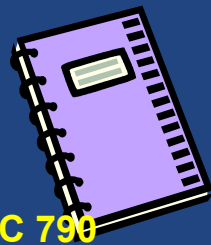
"The assignment of numbers is also handled by Jon. If you are developing a protocol or application that will require the use of a link, socket, port, protocol, or network number **please contact Jon to receive a number assignment**."

Address Management: 1990's

Global routing table: 88-92

- Early 1990's: Internet scaling problems
- Address depletion
  - due to classful architecture (A, B, C)
- Routing table overload
  - Due to lack of route aggregation

9000	
8000	
7000	
6000	
5000	
4000	
3000	
2000	
1000	
0	

Jul-88 Jan-89 Jul-89 Jan-90 Jul-90 Jan-91 Jul-91 Jan-92 Jul-92
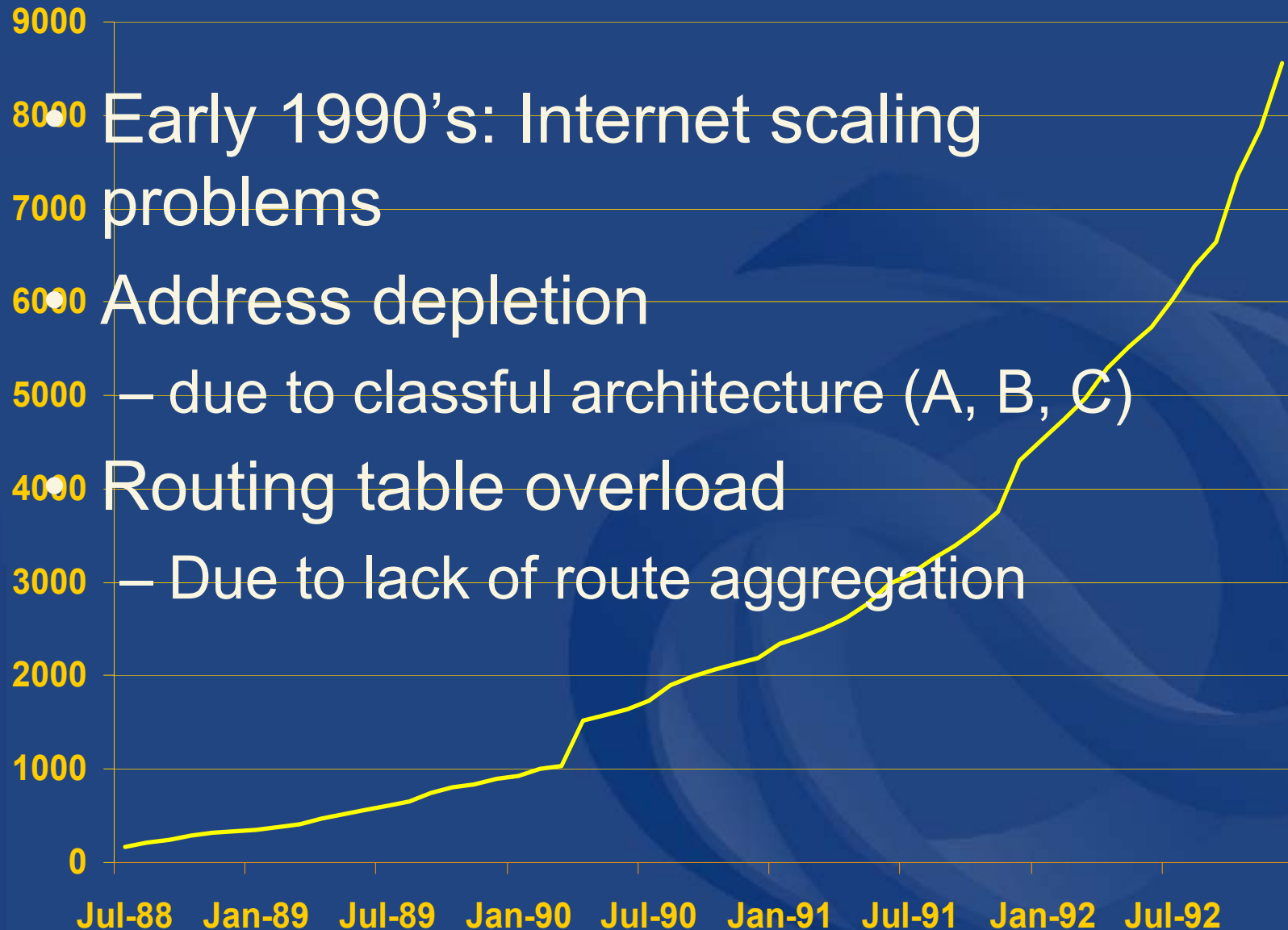
Address Management – 1990's

- Internet widely projected to fail
  - Growth would stop by mid-'90s
  - Urgent measures required
  - Action taken by IETF / Internet community

- 1993: Development of "CIDR"
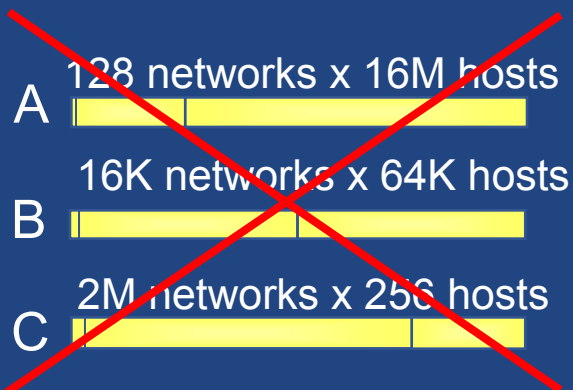 - addressed both technical problems
  - Address depletion
    - Through more accurate assignment
  - Routing table overload
    - Through address space aggregation

RFC 1517
RFC 1518
RFC 1519

Classful & Classless addressing

Best Current Practice

Classful

A — 128 networks x 16M hosts

B — 16K networks x 64K hosts

C — 2M networks x 256 hosts

Obsolete
• *inefficient*
• *depletion of B space*
• *too many routes from C space*

Classless

Hosts	Prefix	Classful
...	...	...
8	/29	
16	/28	
32	/27	
64	/26	
128	/25	
256	/24	1 C
...	...	...
4096	/20	16 C
8192	/19	32 C
16384	/18	64 C
32768	/17	128 C
65536	/16	1 B
...	...	...

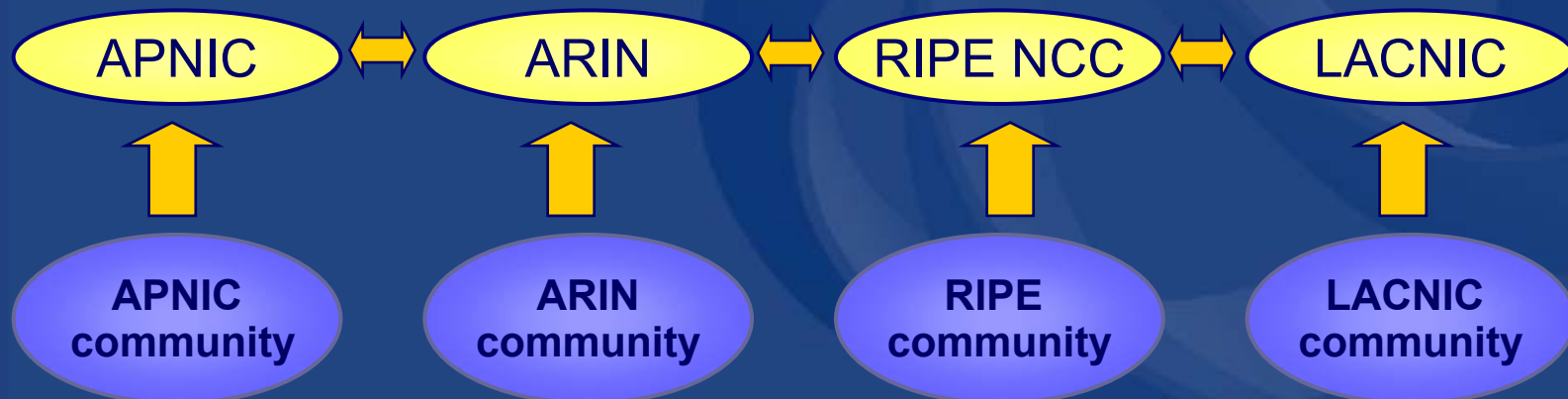• Network boundaries may occur at *any* bit

Address Management – 1992-

- Administrative problems remained
    - Greater complexity of CIDR-based allocations
    - Increasing awareness of conservation and aggregation goals
    - Need for fairness and consistency

- RFC 1366 (1992)
    - Described the "growth of the Internet and its increasing globalization"
    - Additional complexity of address management
    - Set out the basis for a <u>regionally distributed Internet registry system</u>

RFC 1366

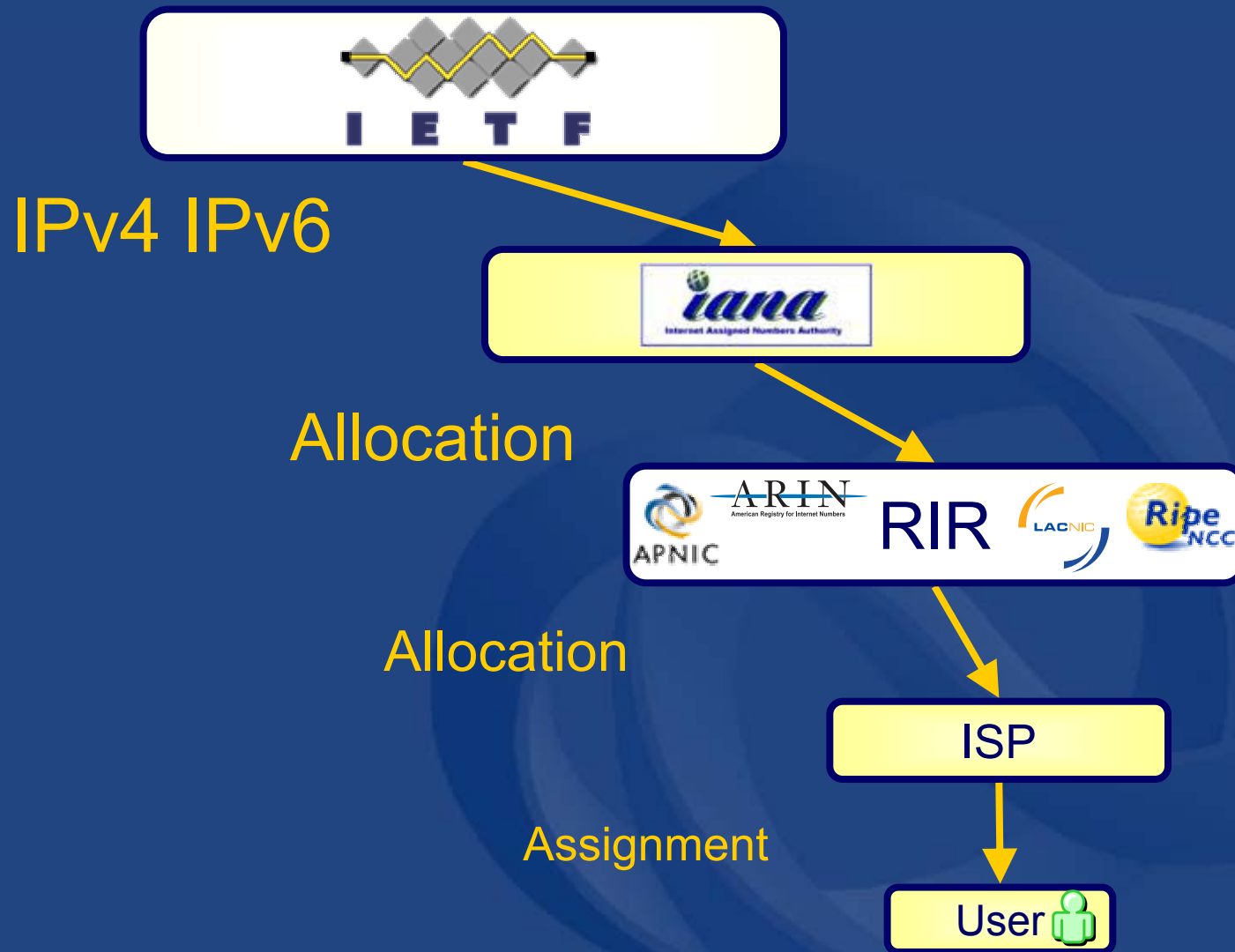# Address Management – 1992-

- Establishment of RIRs
    - APNIC, ARIN, RIPE NCC (LACNIC later)
    - Regional open processes
    - Cooperative policy development
    - Industry self-regulatory model
        - bottom up

| APNIC | ⬌ | ARIN | ⬌ | RIPE NCC | ⬌ | LACNIC |

| APNIC community | ARIN community | RIPE community | LACNIC community |

Address Management – Today

Address Management – Today

IPv4 IPv6

Allocation

RIR

Allocation

ISP

Assignment

User

Where can I get IP addresses?

APNIC   /8

ISP

1. Allocation from APNIC/NIR (A)
2. Sub-allocation from upstream ISP (B)

A

ISP   /12

Member Allocation

B

ISP   /22

Sub-allocation

End-user

1. Non-portable assignment from ISP (C)
2. Portable assignment from APNIC (D)

C   /26
end-user

C   /24
end-user

D   /24
end-user

Assignments
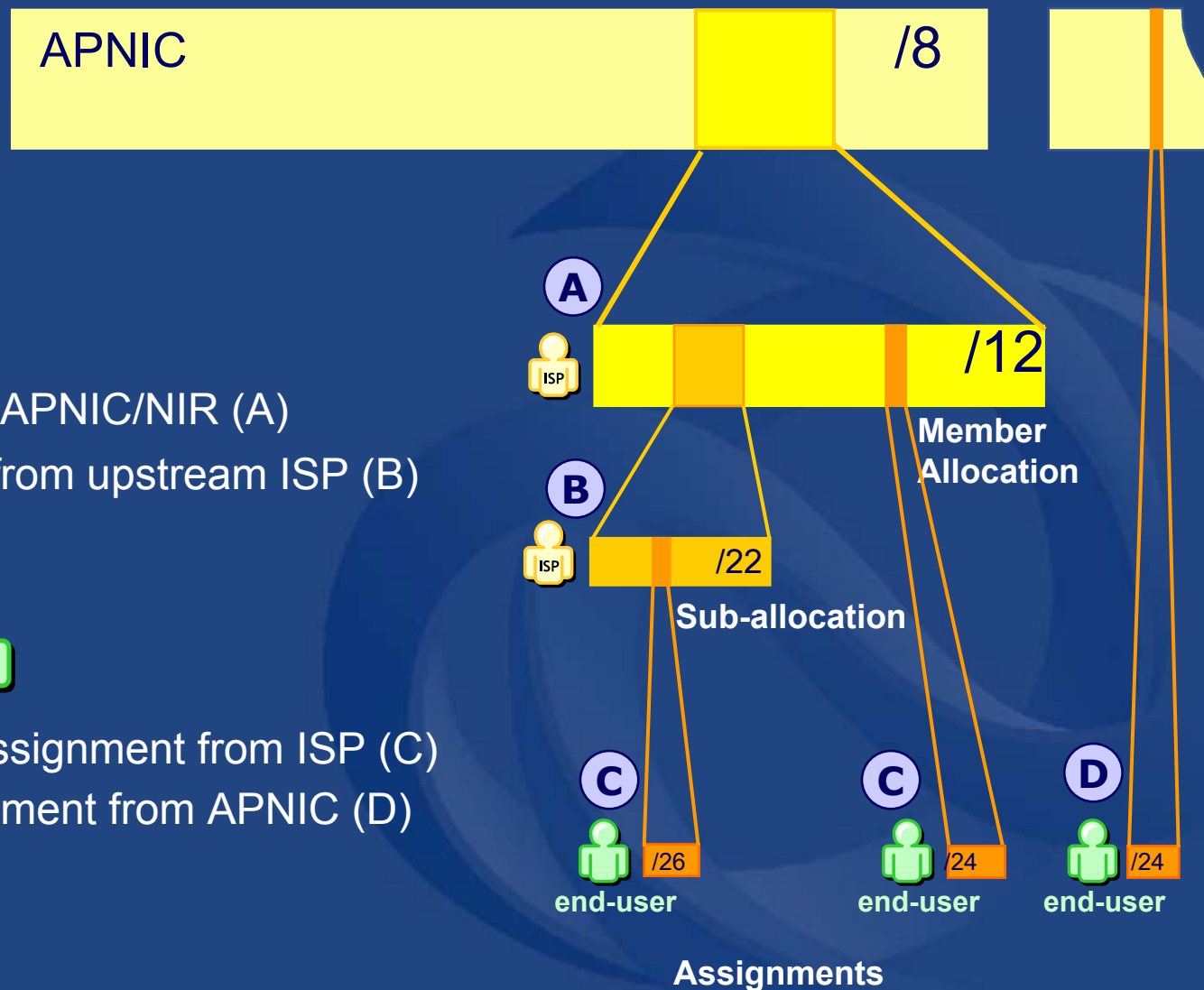
Questions ?

What is APNIC?

What is APNIC?

- Regional Internet Registry (RIR) for the Asia Pacific Region
  - Regional authority for Internet Resource distribution
  - IP addresses (IPv4 and IPv6), AS numbers, reverse DNS delegation

- Established 1993
  - Operating within ICANN (IANA) structure
  - Pilot project of APNG in Tokyo, Japan
  - Relocated to Brisbane, Australia in 1998

APNIC

AS
IP
Resource Services

About APNIC

- Industry self-regulatory body
  - Participation by those who need and use Internet resources
  - Consensus-based, open and transparent
  - Non-profit, neutral and independent

- Membership-based structure
  - Open to any interested party
  - Provides formal structure for cost recovery, election of representatives etc

APNIC mission statement

"Addressing the challenge of responsible Internet resource distribution in the Asia Pacific region."

What does APNIC do?

- Resource services
  - IPv4, IPv6, ASNs
  - Reverse DNS
- Policy coordination and implementation
  - Open bottom-up, self-regulatory
  - Membership reviews and approves policy
- Resource registration
  - Authoritative server: whois

What else does APNIC do?

- APNIC meetings
- Information dissemination
  - Apster
  - Web and ftp site mailing lists
    - http://www.apnic.net/net_comm/lists/index.html
- Training courses & open seminars
  - http://www.apnic.net/training
  - Subsidised for APNIC members
- Infrastructure services
  - Rootserver deployment in 2003

Training

APNIC is not…

- Not a network operator
  - Does not provide networking services
    - Only selected infrastructure services
    - Not a standards body
- Does not develop technical standards
    - Works within IETF in relevant areas (eg IPv6)
- Not a domain name registry or registrar
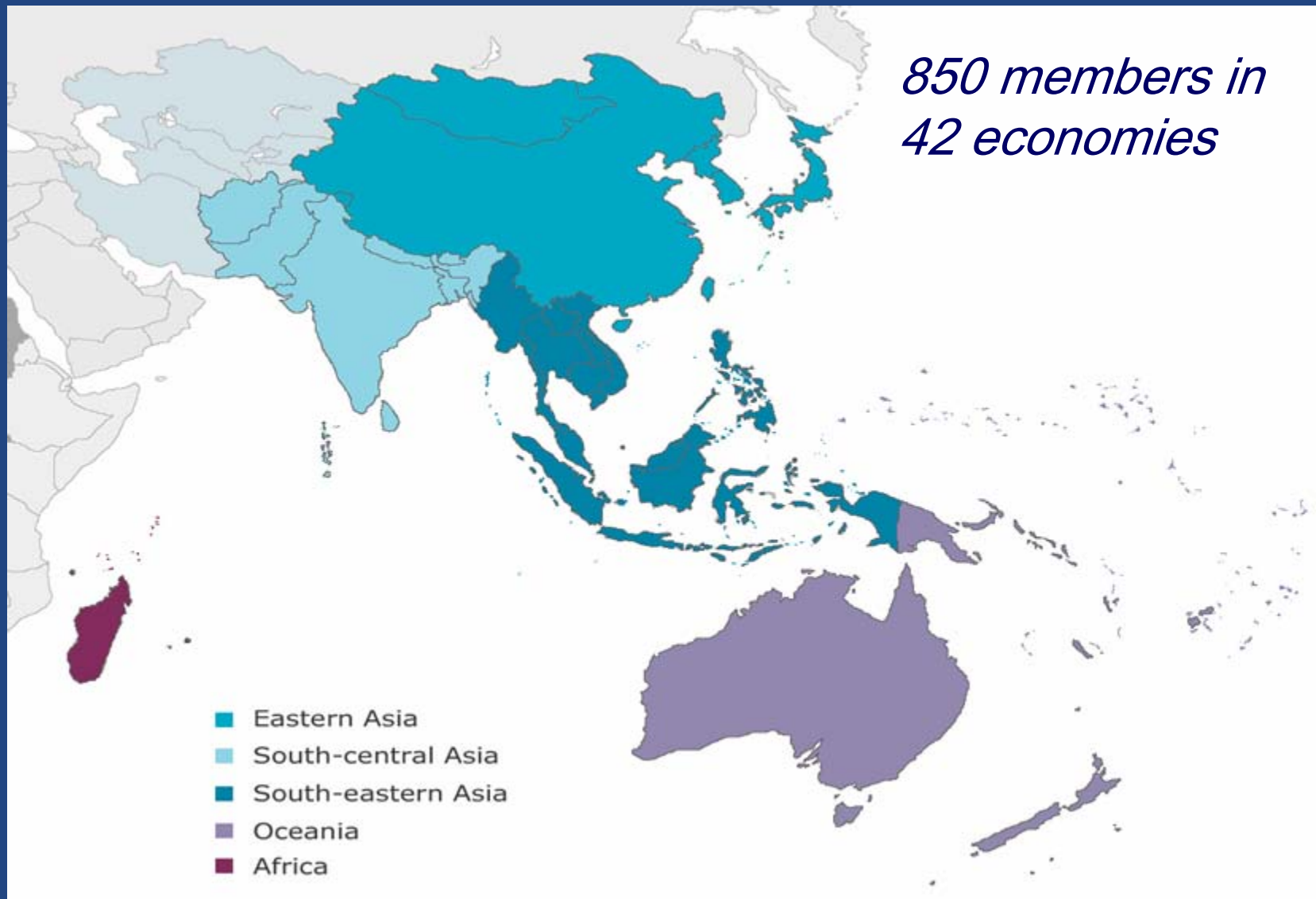   - Will refer queries to relevant parties

Where is APNIC?

APNIC region

850 members in 42 economies

- Eastern Asia
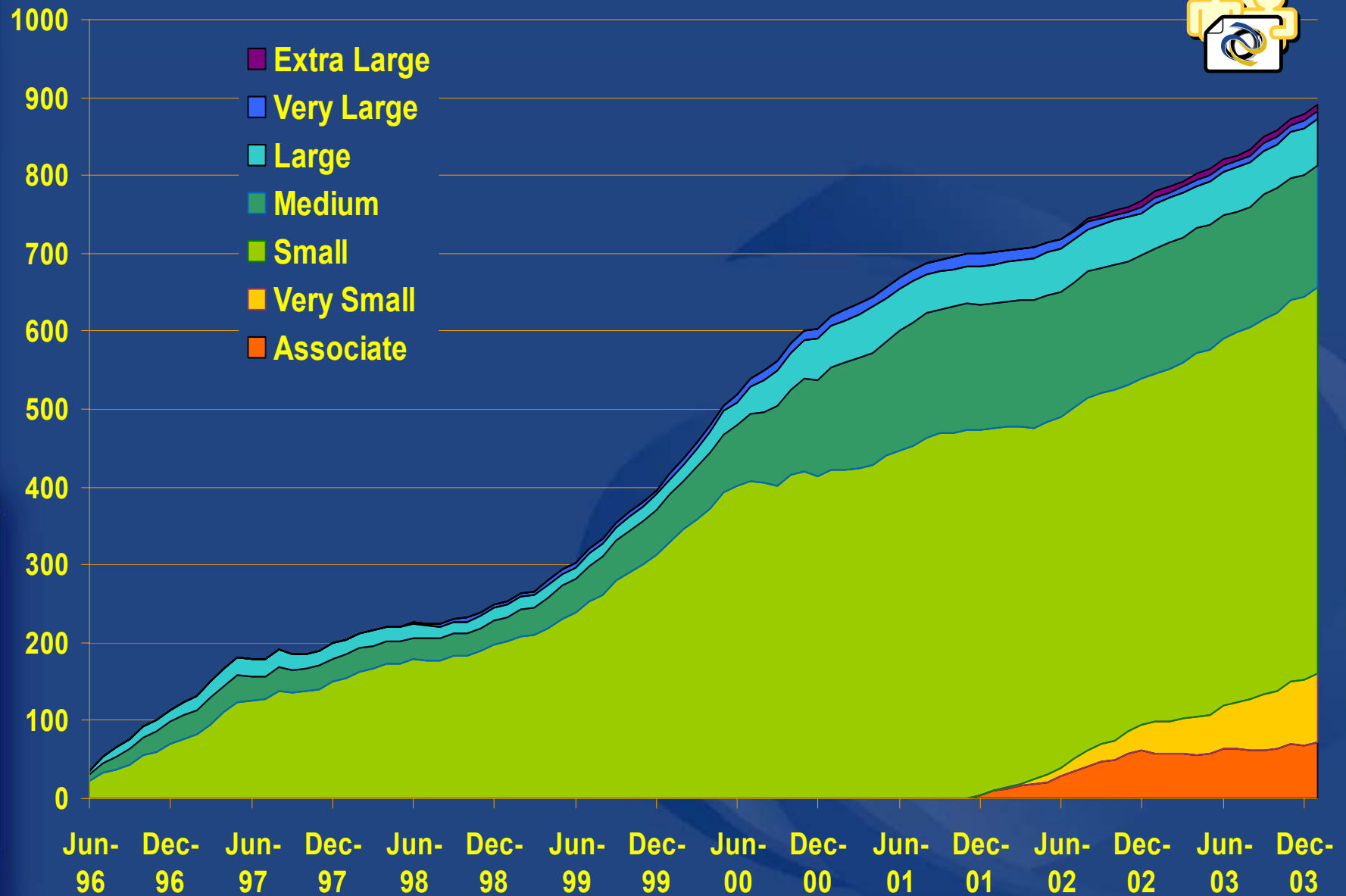- South-central Asia
- South-eastern Asia
- Oceania
- Africa

Asia Pacific Network Information Centre

APNIC

APNIC Membership

APNIC membership

APNIC membership

Membership sub-regions

Pie chart showing membership sub-regions:
- Africa: 3
- East: 223
- Oceania: 273
- Regional: 30
- South-Central: 182
- South-East: 181
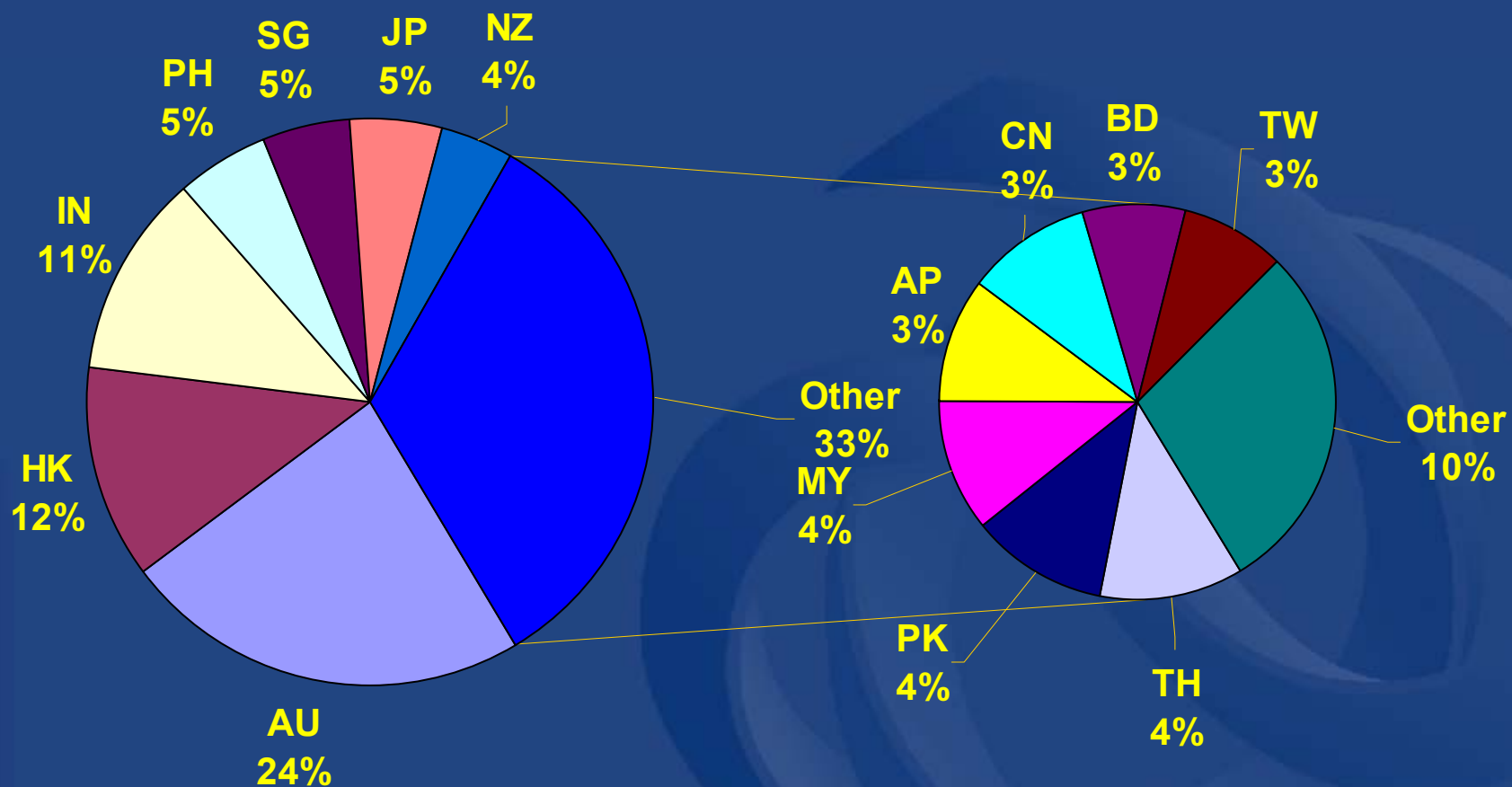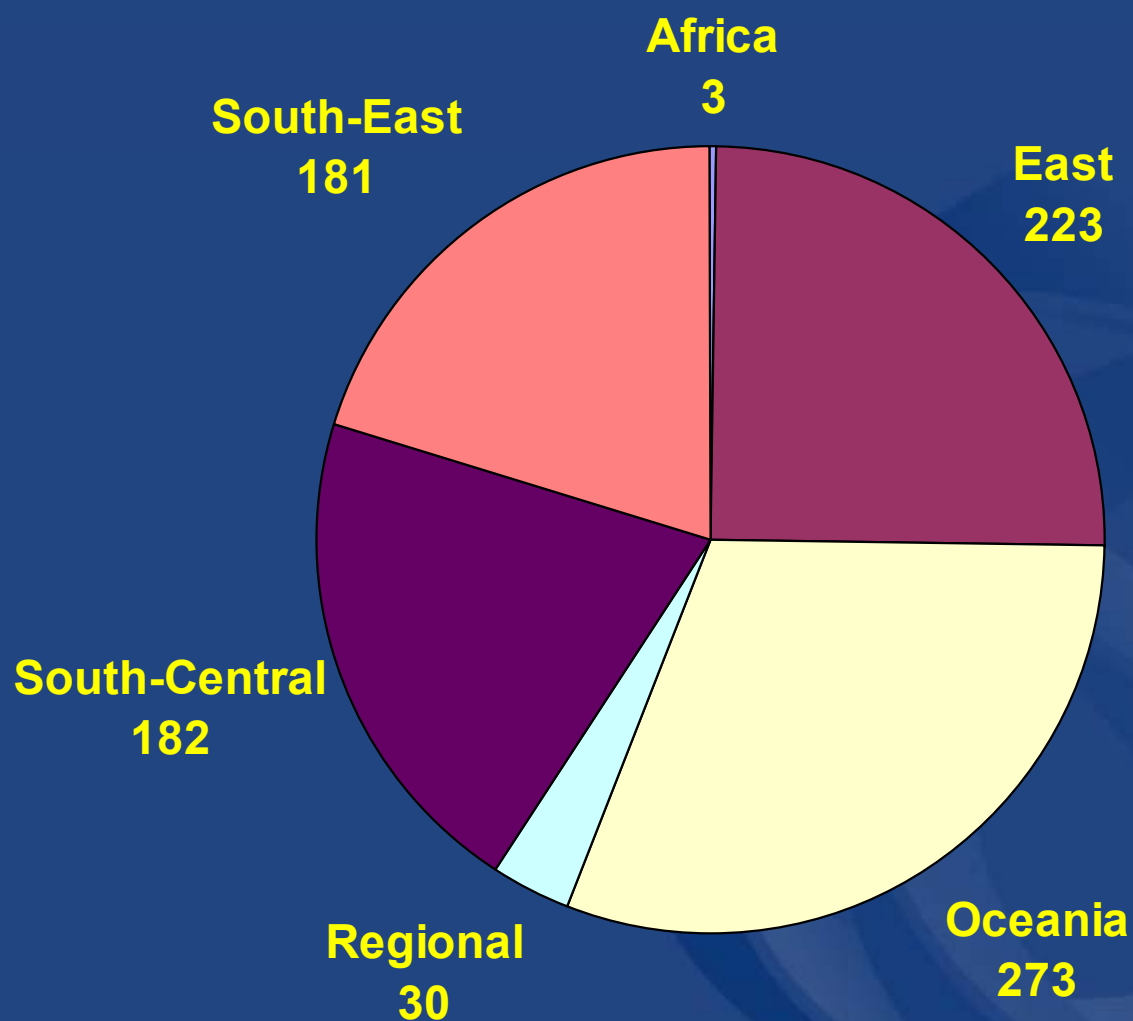
How to become a member

Read docs

Yes

No

Yes
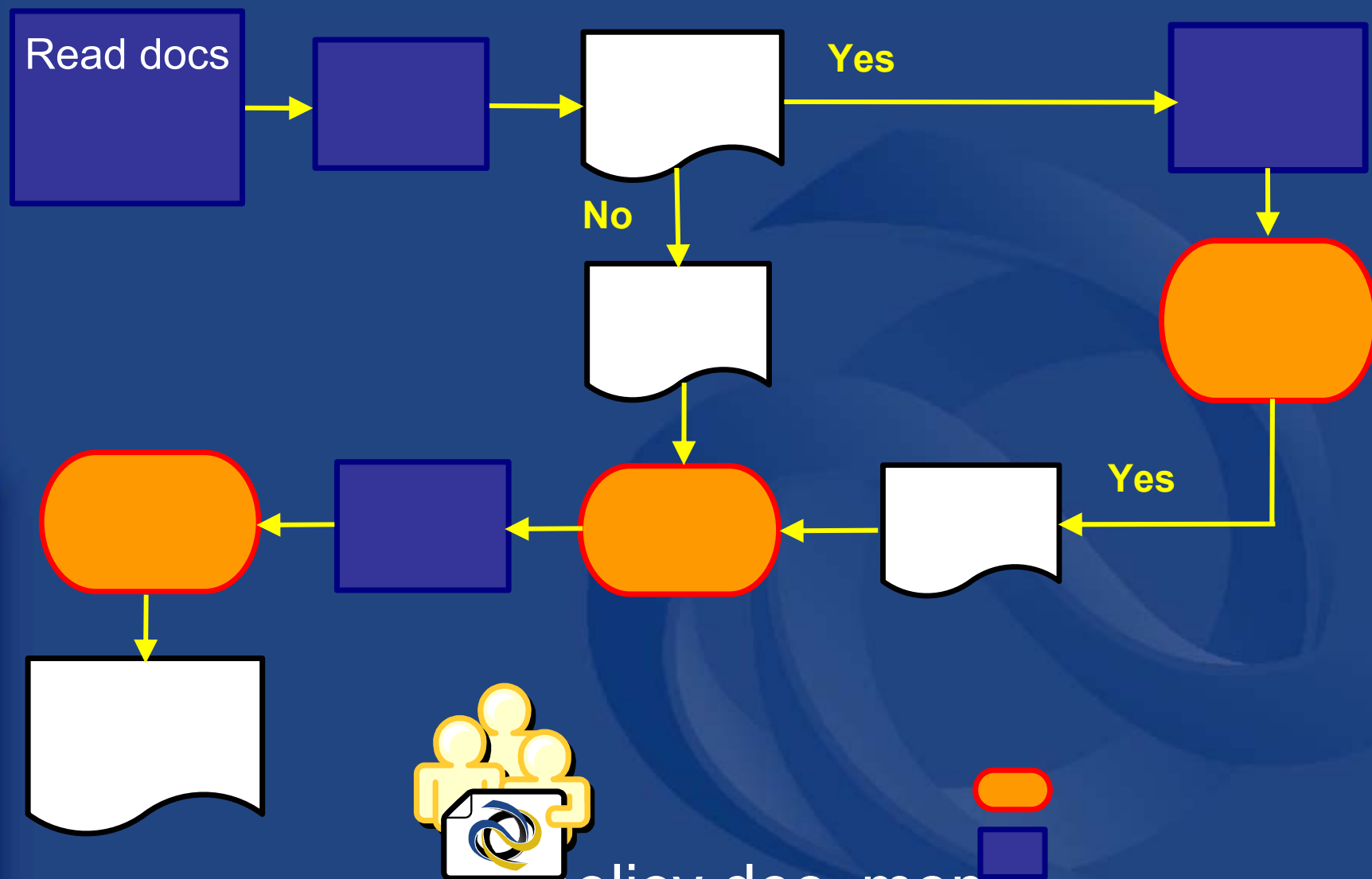
(policy doc, mem

Membership fee structure

Membership tier	Annual fee (US$)	IPv4 space held	IPv6 space held
Associate	$625	None	None
Very small	$1,250	< (incl) /22	< (incl) /35
Small	$2,500	/22 - (incl) /19	/35 - (incl) /32
Medium	$5,000	/19 - (incl) /16	/32 - (incl) /29
Large	$10,000	/16 - (incl) /13	/29 - (incl) /26
Very large	$20,000	/13 - (incl) /10	/26 - (incl) /23
Extra large	$40,000	> /10	> /23

For more information see: http://www.apnic.net/member/

Benefits of APNIC membership

Free attendance at APNIC Members Meetings

Voting rights at APNIC Meetings

Influence in APNIC Activities

Resource Services & Registration Services

Participation in APNIC community

Subsidised APNIC training

•*NOT: Automatic or easier resource allocation*

Internet Registry structure

Asia Pacific Network Information Centre

APNIC

ICANN

IANA

ASO

APNIC ←→ ARIN ←→ LACNIC ←→ RIPE NCC

APNIC: NIR, LIR, LIR, LIR, ISP, ISP

ARIN: ISP, ISP, ISP, ISP

LACNIC: ISP, ISP, ISP, ISP

RIPE NCC: LIR, LIR, ISP, ISP
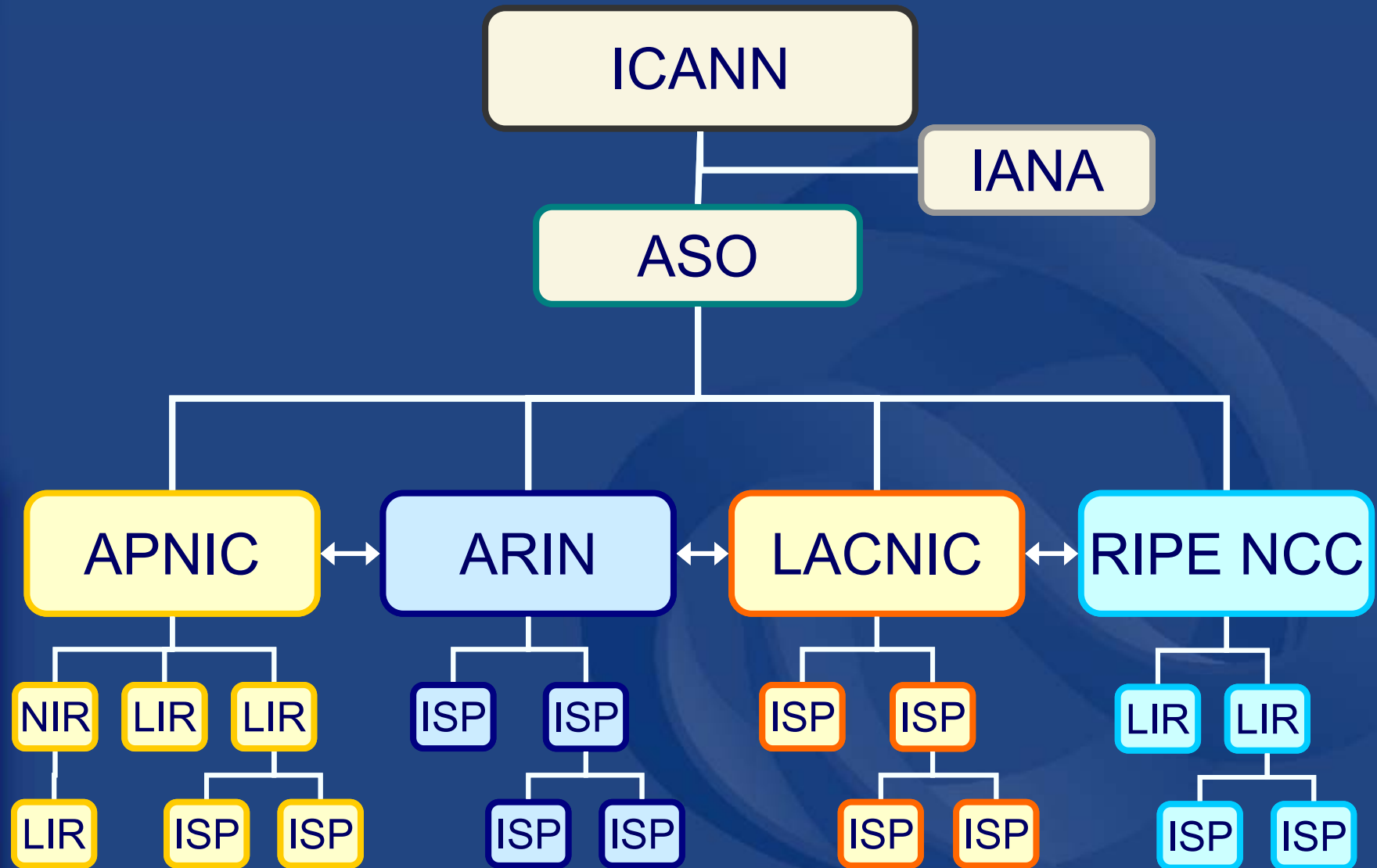
APNIC services & activities

Resources Services

- IPv4, IPv6, ASN, reverse DNS
- Policy development
  - Approved and implemented by membership
- APNIC whois db
  - whois.apnic.net
  - Registration of resources

Information dissemination

- APNIC meetings
- Web and ftp site
- Mailing lists
  - Open for anyone!
- Training Courses
  - Subsidised for members
- Co-ordination & liaison
  - With membership, other RIRs & other Internet Orgs.

Questions ?

Thanks

pwilson@apnic.net